Bridging the Gap: Science Meets Duty

An Honors Thesis (HONR 499)

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Abstract

Organizations such as the American College of Sports Medicine (ACSM) and the American Heart Association (AHA) have produced pivotal research substantiating claims that cardiovascular health is vital to maintaining one's overall health and well-being. The ACSM routinely updates its guidelines as to the duration and intensity recommended for cardiovascular health, and the AHA releases its own standards for general heart health and statistics of national cardiovascular event occurrence, including heart attacks. The National Guard Fitness Assessments project was designed to facilitate the adherence of National Guard soldiers to these guidelines with the intention of maintaining their abilities to serve in the military should they be mobilized. Additionally, upperclassmen Ball State University Exercise Science majors utilized this project as a method of practical application. Thus, the project was a symbiotic relationship between students beginning their careers and America's soldiers, allowing both parties to experience benefits from their efforts.

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Process Analysis Statement

Until I continued my education as an upperclassman exercise science major, I considered myself to be a largely book-based learner. My underclassman courses, such as biology and chemistry, enlightened me to my anxieties associated with lab-based learning, and thus I was more comfortable with learning material from taking notes and more abstract methods than skills-based exercises. In EXSC 301, Fundamentals of Exercise Prescriptions, course materials covered dealt largely with factors associated with exercise and how conditions one might have would affect those factors. I learned how to measure a blood pressure, resting glucose measurements that were considered normal, and a variety of other useful skills. As the course progressed, these skills and others became more commonplace in my routine, and as I practiced them I began to grow in my confidence at performing them.

At the same time these changes were occurring with my learning style, I was exposed to the National Guard Fitness Assessments Project. This project turned out to be one of the most influential experiences of my college career and has had a lasting impact on me because it was a featured portion of arguably one of the two most hands-on classes that I enrolled in. The skills that had been practiced only in the classroom were now applied to adults not enrolled in our classes; a concept that seems so insignificant was foreign to me and served as a robust learning experience. One of my most vivid memories is walking my soldier through his Health History Questionnaire, or HHQ, in which the individual answered a variety of questions about his personal health and well-being, including whether or not the signs and symptoms associated with cardiovascular and respiratory conditions are present, if they smoke or use alcohol, and what conditions are present in their first-degree relatives. I also learned the value of a critical piece of paperwork called an informed consent; soldiers enrolled in the Indiana National Guard (ING)

Fitness Program were required to read, understand, and sign a document detailing the risks and benefits of participating in our program. Included in this paperwork is a clause that explains that students and BSU faculty have the ability to utilize that specific soldier's exercise and health data for teaching purposes. This documentation is the reason why I am retroactively able to use this wide range of data for not only this thesis project, but also my departmental honors curriculum.

From this point forward, my entire involvement in the National Guard project was enjoyable. The HHQ was administered and reviewed as one of the first steps in what the Army referred to as the diagnostic testing (we students used this as our initial point of data gathering and the basis of our exercise prescriptions). Diagnostic testing allowed me to practice taking skinfold measurements and waist-to-hip circumference ratios to determine body composition, height and weight to determine BMI, blood pressure and heart rate to determine cardiovascular baseline levels, handgrip to assess overall strength levels, and sit-and-and reach to analyze flexibility. These measures were repeated during the Army's Record testing later in the semester after the soldiers had completed their exercise prescriptions. Ideally, they would have progressed through the first four weeks of the initial phase, and transitioned in to the improvement phase for stage for the remainder of the designated exercise prescription. Additional transitions were not provided to the soldiers due to the limited time frame students were able to work with them. Significant improvements should be witnessed, then, when data is compared between the same soldier's diagnostic and record tests (pre- and post- prescription). After comparing this data, summary sheets were drafted and delivered to the soldiers where their values were shown alongside each other, and an overview of the results was provided at the bottom of the page.

The ING program impacted more than just the soldiers enrolled in it, it also had a resounding impact on the students who were even tangentially involved. Interns for the Clinical Exercise Physiology Program at Ball State, which is a graduate-level track, mentioned that they enjoyed being able to assist students as they learned pivotal skills that would transfer over to several different career options for them. Before I began my internship with that same program, I was able to help students in the same way; I was present for an additional year's diagnostic and record testing and was excited to be a resource for students taking the same course I had just completed the semester before. This was the first memorable time in my undergraduate career that I was in the position to genuinely help fellow students in this way, and it inspired me to become an intern with the same program that had also assisted me.

As with any involved project, the ING Fitness Project presented its own unique sets of challenges. The program itself operated from the fall semester of 2013 until the spring semester of 2016, which translates to at least a hundred students participating every year and a variable number of soldiers enrolling in the program each semester with some repeats. With such a large pool of individuals, and a significant amount of them being students, several issues came to light. Chiefly among them was a standard lack of communication between groups of students and their particular soldier for whom their exercise prescription was drafted. Having experienced this issue myself, I can say that email communication seemed to be the most reliable, at least in my case, but that as a group we had to be diligent about reaching out to our soldier for updates. The learning experience that emerged from this was that communication truly is vital to professional relationships, whether the focus is explaining topics or exercises, emailing with an individual, or operating as a group to form an exercise prescription.

While this program offered traditional challenges encountered with group work, there were significantly more positive insights the program offered to us students, and me especially. One characteristic I witnessed most often was simple: people are often intrinsically motivated. This may sound counter-intuitive given that soldiers enrolled in this program were often recommended by their commanding officers due to lacking performance in physical testing, but I found that those who truly wished to improve stuck to their prescription and saw changes to their abilities over the course of the semester. Similarly, I noticed that everyone starts somewhere; some enrolled in the program being able to do ten pushups while others could perform forty, or they could perform exceptionally well during the run but were lacking in areas of muscular endurance. Our goal as students in exercise science is to meet individuals where they are and provide them with the tools for success, whatever that means for them specifically. I also learned that small differences can be dramatic in nature; much more effort goes in to seemingly minute changes than what may be visible to others. An individual losing one centimeter of their waist circumference translates in to hours of repeated effort in the gym or at home, and that speaks volumes about their dedication.

The National Guard Fitness Assessments Program has impacted me in more ways than I originally understood when I began my Honors Thesis project. In the early stages of writing, I noticed only the professional differences in myself, but as I delved deeper in to this process, other differences within myself and how my thinking changed became evident. Retrospectively I can see a drastic alteration in the way I view progress. While I used to understand it as changing for the better, I now focus on an abstract definition that involves the entire person; someone does not have to make leaps and bounds in their abilities to have made progress. Progress is a process that takes physical and emotional time, and not all of these processes are visible or even

perceptible as they are occurring, but are often only visible through a retrospective lens. One could say that my faith in change grew immensely during this project.

In addition to this altered perception regarding the process of change, I viewed other aspects of my profession in new ways, also. The idea of supporting others has adopted a deeper and more professional level to me as it has become intertwined with the path I have chosen for my career: physical therapy. I have grown in the confidence I have in myself and in the knowledge that I possess. Through practicing various skills, I have improved my technique in executing them where applicable. Managing the presence of an anxiety disorder has improved my abilities as well, especially in areas of verbal communication. My passions have always lain with helping others, and after passing through this project and benefiting exponentially from its experiences, I feel that I can be successful in my career.

Bridging the Gap: Science Meets Duty

Introduction

In 2013, Army commanders approached team members of what is now Ball State's School of Kinesiology in the spring with a proposition for a program that would benefit the National Guard and undergraduate students alike. There were many national guardsmen and women that were failing or nearly failing the Army Physical Fitness Test, or APFT. Likewise, there were hundreds of students currently enrolled in upper-level Exercise Science courses who were developing their skills. For two years, four semesters of students cycled their way through the National Guard Fitness Assessments program, sharpening practical skills related to exercise science for their future careers and assisting America's soldiers in improving their physical readiness to perform their duties as servicemen and women.

The collaborative efforts proposed several benefits for both students and servicemen; students gained real-world experience while the soldiers were given assistance with reaching for their fitness goals. At the time, Ball State's tag line was "Immersive Learning", and this project surely lived up to that expectation. It was an integrated student experience that allowed for practical application of transferrable skills while simultaneously assisting military service members with meeting specific and attainable goals. The basics of student involvement were wide-reaching, including measuring vital signs (blood pressure and heart rate), flexibility (sit-and-reach), body composition (three-site skinfolds and hip-to-waist ratios), basic strength (handgrip), and exercise prescription (creating an individualized plan for one to two soldiers). Students were introduced to these skills in their upper-level coursework and encouraged to utilize in-class lab sessions to practice these skills prior to meeting with their soldiers.

Scientific Evidence: Cardiorespiratory and Resistance Exercise

The simplest way to understand how exercise and the body are related is medically. Exercise is medicine; it assists in combating health-related conditions, from mental to physical abnormalities, in many of the same way western medications do. The recommendations the American College of Sports Medicine (ACSM) provides regarding cardiorespiratory and resistance exercises varies due to the differences in the body's reactions to these different types of training. Regular cardiorespiratory exercise decreases the strain on your heart, lowering the risk of developing certain conditions and of experiencing heart-related events. These may include but are not limited to hypertension, heart disease, ectopic (abnormal) beats, and cardiac arrest. By decreasing the body's blood pressure and resting heart rate, the overall risk for developing heart-related conditions decreases. Simply put, exercising the heart consistently leads to a healthier heart and one that is more resistant to various afflictions. (Team, 2016).

Current ACSM recommendations for cardiorespiratory exercise, as of 2018, involve a series of coordinated intensities and durations of exercise. The organization recommends that individuals participate in a total of one hundred fifty minutes of cardiovascular exercise, which, when divided in to increments, can be broken up various ways. The most common routine is exercising five days per week for thirty minutes to an hour per day at a moderate intensity, but a slightly more challenging option is to exercise three days per week for twenty minutes to an hour per day at a vigorous intensity. The good news for any person who finds themselves short on time is that exercise can also be come in increments of at least ten minutes, meaning that if one were to participate in three ten-minute bouts of cycling at a moderate intensity, and if that person were to routinely do this for five days per week, they would reach their exercise goals per ACSM. (ACSM, 2018).

These recommendations are about more than just general health and well-being. The medical community can sound like a broken record when addressing health concerns; usually one of the first recommendations for an individual comes in the form of "exercise and eat well", or in some variation. However, usually the conversation stops at that point, so a majority of individuals receiving this advice are given a small piece of the truth for the sake of convenience. Regular cardiovascular exercise benefits more than just the heart; it affects all areas of the body, including the brain, skin, and bones. It decreases the risks of strokes, improves memory, and is a proactive approach against the development of Alzheimer's. For those struggling with the family of Anxiety and Depressive disorders especially, exercise can be a liberating treatment. Exercise also provides enhanced profusion of blood to the skin, improving its clarity and overall health. It also acts on the blood itself, helping to regulate blood glucose and cholesterol levels, which impacts heart disease and diabetes. Perhaps one of the most overlooked benefits is the effect exercise has on the muscles; when engaged in regularly, performance increases which allows for greater intensities to be sustained for longer durations. By putting tension on the bones over time, exercise lowers the risk of one developing osteoporosis and arthritis. The lungs win too; regular exercise increases the amount of oxygen that is available during those workouts. Given the current statistics regarding obesity in the United States, the effect that exercise has on one's weight may be one of the most important benefits of exercise; exercise lowers the body's fat mass and raises the body's muscle mass, which works hand-in-hand with many of the previously mentioned conditions. (Team, 2016).

The American College of Sports Medicine (ACSM) has specific guidelines concerning resistance training, just as it does for cardiorespiratory exercise. As with cardio training, resistance training improperly can result in injury or diminished results. General

recommendations from the ACSM involve resistance training two or three days per week, making sure to wait at least 48 hours between bouts of exercise to give the muscles adequate time to repair themselves. Fifteen to twenty repetitions per one set is preferred, but the number varies depending on the weight moved. Repetitions and weight have an inversely proportional relationship; that is, the higher the number of repetitions per set, the lower the weight or resistance against the body should be. Likewise, if the number of repetitions per set is on the lower range, then the weight moved per repetition should be larger. (ACSM, 2018).

Benefits to the National Guard

Two seemingly conflicting statements apply to the question of why this program was beneficial to the National Guard. One is that "some is better than none" and "you reap what you sow". Doing your best, even if you are unable to do all of what is expected of you, is still better than having done nothing at all; in the case of exercise, it is important to realize and understand that the body is an amazing piece of machinery, but it does take time and training to improve, just as it took time to develop in to its current state. Patience is necessary. By the same token, pushing oneself is important because that is how the body adapts and grows stronger or healthier. The trick is to balance these two expectations of working hard and not pushing too hard, all in the same program.

Exercise plans are tricky for most individuals to wrap their heads around; typically the less experience one has with exercise, the less confident that person feels in forming a plan for themselves. This is why the partnership between the exercise science students at Ball State and the Indiana National Guard is beneficial; the students are given an opportunity to not only develop an exercise prescription for a soldier, but also to coach them and to provide suggestions

to them. The students are also available at any point in the process to answer questions or adjust the prescription as needed. The key to this process is communication, so without open communication between soldiers and students, the likelihood of the exercise regimen succeeding, and of the soldier passing the APFT, decrease. Similarly, the odds of the soldier achieving a lower run time or performing more sit-ups or pushups depends on the amount of effort that was put in to the routine; results are more likely to be achieved if the routine is kept up. This goes hand-in-hand with enlistment, sometimes directly, because the soldiers must maintain a certain level of fitness to stay a soldier of the National Guard, so the more they improve, the more likely they are to score high enough on the APFT to stay a member of the National Guard.

Outside of being beneficial for soldiers' careers, there are aspects of this program that are personally effective for them. First, the program is convenient. The soldiers do not need to devise their own workout plan; exercise science students spend hours choosing the correct exercises with the ideal number of sets, repetitions per set, and amount of rest between sets to be taken. They also devise a warm-up that prepares the soldier for their workout and a cooldown that returns their body to heart rates and blood pressures near resting levels. Along the same lines, the program is also individualized for the specific soldier; students work in groups of four or five, and each group has one to two soldiers assigned to it. This low ratio enables the students to cater the program to the specific needs of the soldiers. If restrictions are present, such as a previous injury to be aware of for example, this type of group setting allows for those needs to be more easily and readily met. It also allows for a more personally professional relationship to develop; the students get to know their solders' job, their lifestyle, their time commitments, and what support system they have available to them. For instance, if a soldier has access to a gym at their location of employment, then the students know that they can devise a program that has specific

equipment in it, but if the soldier can only exercise at home, then the bodyweight exercises would be more appropriate. Lastly, this program offers soldiers a way to learn more about health and living a healthy lifestyle. When a soldier is present both for their diagnostic and record tests, they are able to see what their initial (diagnostic) data was, which includes a body fat percentage and various resting measurements such as resting heart rate, and compare these values to their final (record) tests of the year. This information can be used to determine what lifestyle alterations could be made to better improve their health as well as how to change those aspects.

Data Analysis and Results

The analysis portion of this project centered around cardiorespiratory fitness because it has long-lasting effects on the body's general health and well-being. This area of research has been well-researched and is continually updated; updated guidelines for the amount of exercise one should engage in as well as the benefits of exercise in various conditions are renewed at least every couple of years. These benefits essentially boil down to the same two physiological responses: decreases in resting heart rate and decreases in resting blood pressure. Heart disease is a major cause of medical expenses for the average American population annually and heart-related conditions can lead to costly hospital stays and procedures. This is part of the reason the APFT includes a rigorous assessment of cardiorespiratory fitness; not only does the military want to ensure that their soldiers are fit and able to perform their duties, they are also expected to be relatively healthy individuals. Soldiers were given compensatory allowances if needed, such as participating in the 2-mile walk rather than the 1.5-mile run if an injury hindered their abilities.

Not all soldiers who were part of the program were included in the data analysis; some only had data collected on the diagnostic test, and some only had data collected on the record test. For accurate measurements from the statistical software, pre- and post- data sets were required from all soldiers. Because of this, the subject pool tested is smaller than the total number of soldiers that enrolled in the program. Twenty soldiers' values were tested using a univariate ANOVA analysis with Descriptive SPSS v. 24.0. Of these values the clearest differences between the diagnostic and record tests was in their cardiorespiratory fitness levels. Although there was no statistical significance between data points for cardiorespiratory fitness, the data was trending in the appropriate direction. Statistical significance is explained as being a value of 5% ($p<.05$), and the value associated with the soldiers' data points was 0.639. What this data tells us is that substantial improvements did not occur across the board when pre-prescription performance was reviewed in relation to post-prescription performance. Specific individuals may have improved more than the analysis software indicated, but that was not the purpose of this analysis. It is also uncertain to indicate whether or not those who participated in the program were adherent to their exercise prescriptions; accurate representations of this were simply not possible, due in part to poor communication between students and their soldiers.

Program Limitations

As in any arrangement between groups of individuals, communication can be difficult. In the case of this program, communication was severely lacking between soldiers and their students. Whether this was intentional or a product of busy schedules cannot be determined. It is possible that soldiers' commitment levels to the program affected their communication with their assigned students. Those that entered the program voluntarily tended to be more receptive than

those whose entry was mandatory, although this was not exclusively the case. As previously mentioned, time constraints quite possibly played a role on both sides of the relationship.

One drawback consistently occurred between spring and fall semesters during the same year. The Army uses a streamlined calendar to set their diagnostic and record testing dates and agrees to perform this testing in the Field and Sports Building on Ball State's campus. Ball State does not always start calendar years on the same week as previous years, and thus not all courses' schedules' line up the same as they did in previous years. For these reasons, students enrolled in the same course in different semesters or in different calendar years would most likely not have the same length of education prior to the diagnostic testing or the record testing by the time those dates arrived, leading to some groups not being as proficient at more difficult measures than other students. However, professors and highly competent students always acted as supervisors and as resources for those who were struggling to complete assessments. Additionally, many of the assessments conducted by students were centered on basic areas of fitness, such as body composition and resting blood pressure; the Army assessed the muscular endurance and cardiorespiratory fitness assessments.

Conclusion

As with any project, there is always room for improvement. To see the project from the eyes of the students involved, a survey was provided asking several types of questions regarding the interest level students had in the program and the impact that the program had on them. Of the forty-two students surveyed, most answers to these questions were in the "very good" or "excellent" categories, with a select number of students indicating the experience was "okay". A majority of the students involved in the project appreciated the presence of the project as an

addition to their curriculum. Many took the opportunity to use the skills learned and expand upon their knowledge, and a high majority of students surveyed felt that the soldiers involved benefitted positively from the experience.

The National Guard Fitness Assessments Project is no longer in operation. Some may view this cessation as a sign of failure, but I see it from another perspective. Admittedly, the program did not work as well as designed; in an ideal world, largely statistically significant findings would be found, immense improvements visible, and everyone involved would always do their best. This is a not a perfect world, and some of those ideals were not realized. However, the project did demonstrate that two separate entities can work together to work through a common problem. The military partnered with a university associated with one of the foremost entities in Human Performance research in the country, and although the results were not ground-breaking improvements, there were still improvements. In the fitness world, that is what *truly* what leads to a successful and fulfilling life.

Appendices

Included in this section is an example of a summary sheet given to soldiers after their involvement in the program. In this particular case, the individual was involved in the program on two occasions and improved in several areas of fitness. Reference ranges for each applicable value are included on the right-hand side of the summary sheet to aid with comparisons of data from year to year. These ranges indicate various measurements that are either considered "normal" according to sex or those considered "abnormal" according to sex. With exercise, several measures decreased, which shows improvement. For instance, their resting blood pressure decreased, and while their weight stayed consistent, one can see changes in their percent fat measurements by comparing the skinfolds between the 2015 and 2017 measurements. Their muscular endurance capabilities increased markedly, measured through pushups and sit-ups. This information was then summarized at the conclusion of the sheet.

Also included in this section is a list of references used in the main body of this project, mainly as additional sources of information to promote evidence-based statements I have made.

Ball State University Exercise Science National Guard Fitness Program Fitness Evaluation Results

Resting Data	**9/19/15**	**1/21/17**	**Reference Range**
Resting Heart Rate (bpm)	80	78	60-100
Resting Blood Pressure (mmHg) #1	122/60	102/54	<140/90
Resting Blood Pressure (mmHg)#2	122/60	N/A	
Body Composition			
Body Weight	125lbs 56.8kg	125 lb 56.8kg	
Height	67in 1.44m	68 in 1.72m	
Body Mass Index (kg/m-^{2})	19.58kg/m2	19.2 kg/m2	Normal: 18.5-24.9
Skinfolds (mm)			
Site/Female	**Mean**	**Mean**	
Triceps	10.5mm	9.5	
Suprailiac	15.5mm	6.0	
Thigh	20.5mm	20.5	
*Body Density	1.057	1.064	
*%Body Fat	16.56%	13.9%	
Circumference(cm)			<102 (men), <88 (women)
Waist Circumference	69	68	
Hip Circumference	91.25	91	
Waist Hip Ratio	.756	0.747	Very High: >0.95 (M), >0.86(F)
Hand Grip (kg)			
Right	31.8 kg	38	≥50
Left	31.8 kg	40	
Sit and Reach			
Trial 1	27	33	
Trial 2	32	33	
Trial 3	29	35	
%ile rank	Fair	Good	
Exercise Test Data			
Protocol (run/walk)	Run	Run	
Total Test Time (min)	20:06	19:20	
Push Up Test	19	25	
Sit Up Test	49	53	

Summary:

Our results indicate your blood pressure values put you in the "normal" category; you are no longer considered pre-hypertensive. Your BMI is on the lower end of the normal range and indicates an average risk of a heart-related event occurring. Your sit-and-reach scores put you in the "good" category. Your sit-up score indicates you are well above average, and your pushup score puts you in the "very good" category.

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